GROUNDWATER MONITORING

Geological History of the West Valley Site

The West Valley Demonstration Project (WVDP) is located on the dissected and glaciated Allegheny Plateau at the northern border of Cattaraugus County in Western New York. The site is underlain by a thick sequence of Holocene (recent) and Pleistocene (ice age) sediments contained in a steep-sided bedrock valley. From youngest to oldest, these unconsolidated deposits consist of alluvial and glaciofluvial silty coarse-grained deposits, which are found almost exclusively in the northern part of the site, and a sequence of up to three fine-grained glacial tills of Lavery, Kent, and possible Olean age, which are separated by stratified fluvio-lacustrine deposits. These glacial sediments are underlain by bedrock composed of shales and interbedded siltstones of the upper Devonian Canadaway and Conneaut Groups, which dip southward at about 5 m/km (Rickard 1975).

The most widespread glacial unit in the site area is the Kent till, deposited between 18,000 and 24,000 years ago toward the end of the Wisconsin glaciation (Albanese et al. 1984). At that time the ancestral Buttermilk Creek Valley was covered with ice. As the glacier receded, debris trapped in the ice was left behind in the vicinity of West Valley. Meltwater, confined to the valley by the debris dam at West Valley and the ice front, formed a glacial lake that persisted until the glacier receded far enough northward to uncover older drainageways. As the ice continued to melt (between 15,500 and 18,000 years ago), more material was released and deposited to form the recessional sequence (lacustrine and kame delta deposits) that presently overlies the Kent till. Continued recession of the glacier ultimately led to drainage of the proglacial lake and exposure of its sediments to erosion (LaFleur 1979).

Between 15,000 and 15,500 years ago the ice began its last advance (Albanese et al. 1984). Material from this advance covered the recessional deposits with as much as 40 meters (130 ft) of glacial till. This unit, the Lavery till, is the uppermost unit throughout much of the site.

The retreat of the Lavery ice left behind another proglacial lake that ultimately drained, allowing the modern Buttermilk Creek to flow northward to Cattaraugus Creek. Post-Lavery outwash and alluvial fans, including the fan that overlies the northern part of the WVDP, were deposited on the Lavery till between 14,200 and 15,000 years ago (LaFleur 1979). The modern Buttermilk Creek has cut the present valley since the final retreat of the Wisconsin glacier.

Surface Water Hydrology of the West Valley Site

The Western New York Nuclear Service Center (WNYNSC) lies within the Cattaraugus Creek watershed, which empties into Lake Erie about 43 kilometers (27 mi) southwest of Buffalo.

The 80-hectare (200-acre) WVDP site is contained within the smaller Frank's Creek watershed. Frank's Creek is a tributary of Buttermilk Creek; Buttermilk Creek, a tributary of Cattaraugus Creek, drains most of the WNYNSC and all of the WVDP facilities.

The WVDP is bounded by Frank's Creek to the east and south and by Quarry Creek (a tributary of Frank's Creek) to the north. Another tributary of Frank's Creek, Erdman Brook, bisects the WVDP into a north and south plateau (Fig. 3-1).

The main plant, waste tanks, and lagoons are located on the north plateau. The drum cell, the U.S. Nuclear Regulatory Commission (NRC)-licensed disposal area (NDA), and the New York State-licensed disposal area (SDA) are on the south plateau.

Hydrogeology of the West Valley Site

The WVDP site area is underlain by glacial tills comprised primarily of clays and silts separated by coarser-grained interstadial layers. The sediments above the second (Kent) till (the Kent recessional sequence, the Lavery till, the Lavery till-sand, and the surficial sand and gravel) are generally regarded as containing all of the potential routes for the migration of contaminants (via groundwater) from the WVDP site. (See Figures 3-2 and 3-3 [pp. 3-4 and 3-5], which show the relative locations of these sediments on the north and south plateaus.)

The Lavery till and the Kent recessional sequence underlie both the north and south plateaus. On the south plateau the upper portion of the Lavery till is exposed at the ground surface and is weathered and fractured to a depth of 0.9 to 4.9 meters (3 to 16 ft). This layer is referred to as the weathered Lavery till.

The remaining thickness of the Lavery till is unweathered. This unweathered Lavery till is predominantly an olive gray, silty clay glacial till with scattered lenses of silt and sand. The till ranges up to 40 meters (130 ft) in thickness beneath the active areas of the site, generally increasing towards Buttermilk Creek and the center of the bedrock valley.

Hydraulic head distributions in the Lavery till indicate that groundwater flow in the unweathered till is predominantly vertically downward at a relatively slow rate, towards the underlying recessional sequence. The mean horizontal hydraulic conductivity of the unweathered till, as determined from sixteen wells tested in 1996, was 4.2×10^{-8} cm/sec (1.2×10^{-4} ft/day). Previous values of vertical and horizontal hydraulic conductivity obtained from laboratory analysis of undisturbed cores and field analyses of piezometer recovery data suggest that the unweathered till is essentially isotropic, i.e., it has equal hydraulic properties in both vertical and horizontal directions.

The underlying Kent recessional sequence consists of alternating deposits of lacustrine clayey silts and coarse-grained kame delta and outwash sands and gravels. These deposits underlie the Lavery till beneath most of the site, pinching out along the southwestern corner where the bedrock valley intersects the sequence.

Groundwater flow in the Kent recessional sequence is predominantly to the northeast, towards Buttermilk Creek. The mean hydraulic conductivity, as determined from thirteen wells tested in 1996,

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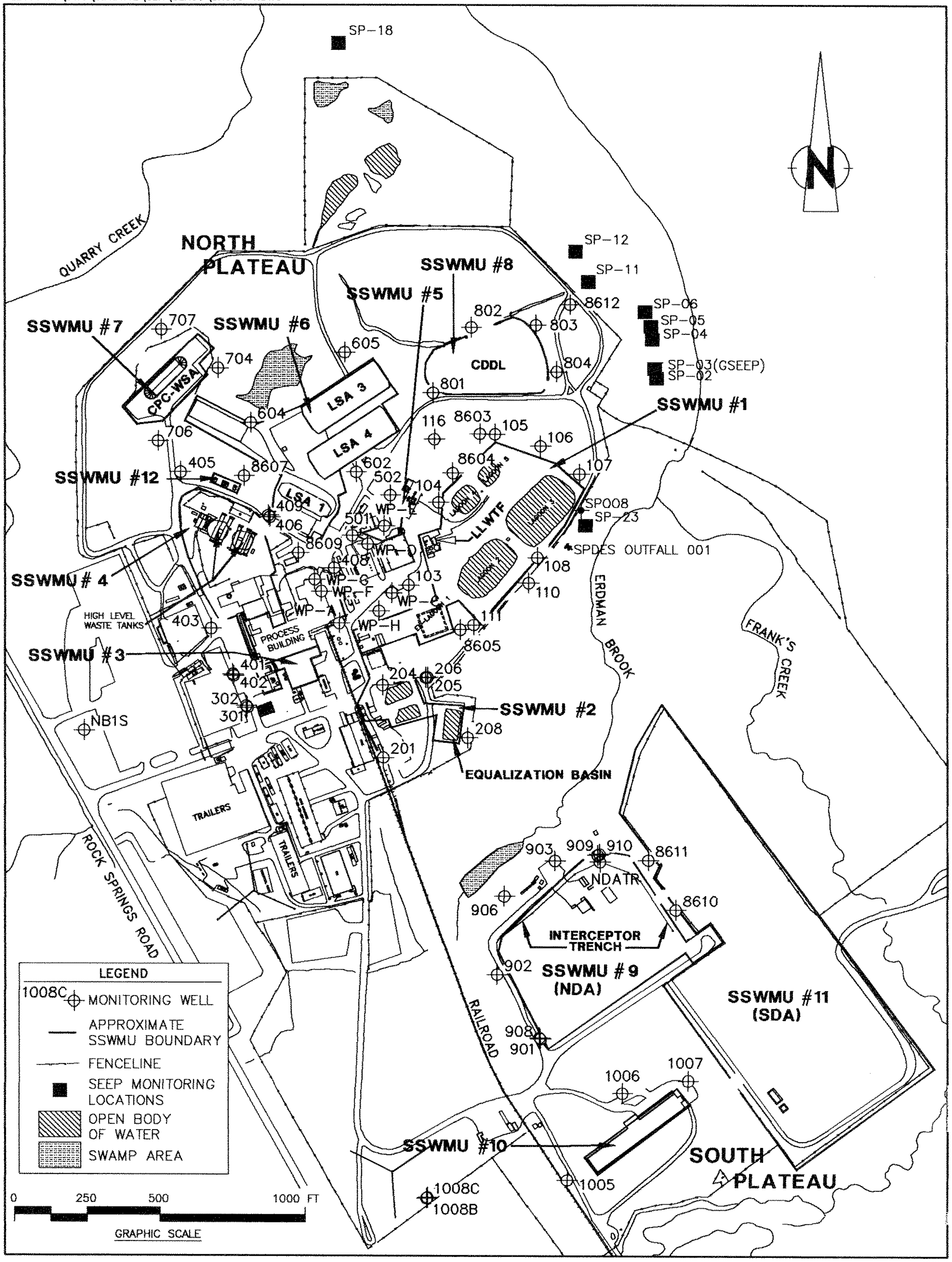


Figure 3-1. WVDP Groundwater Monitoring Program Locations Sampled in 1996.

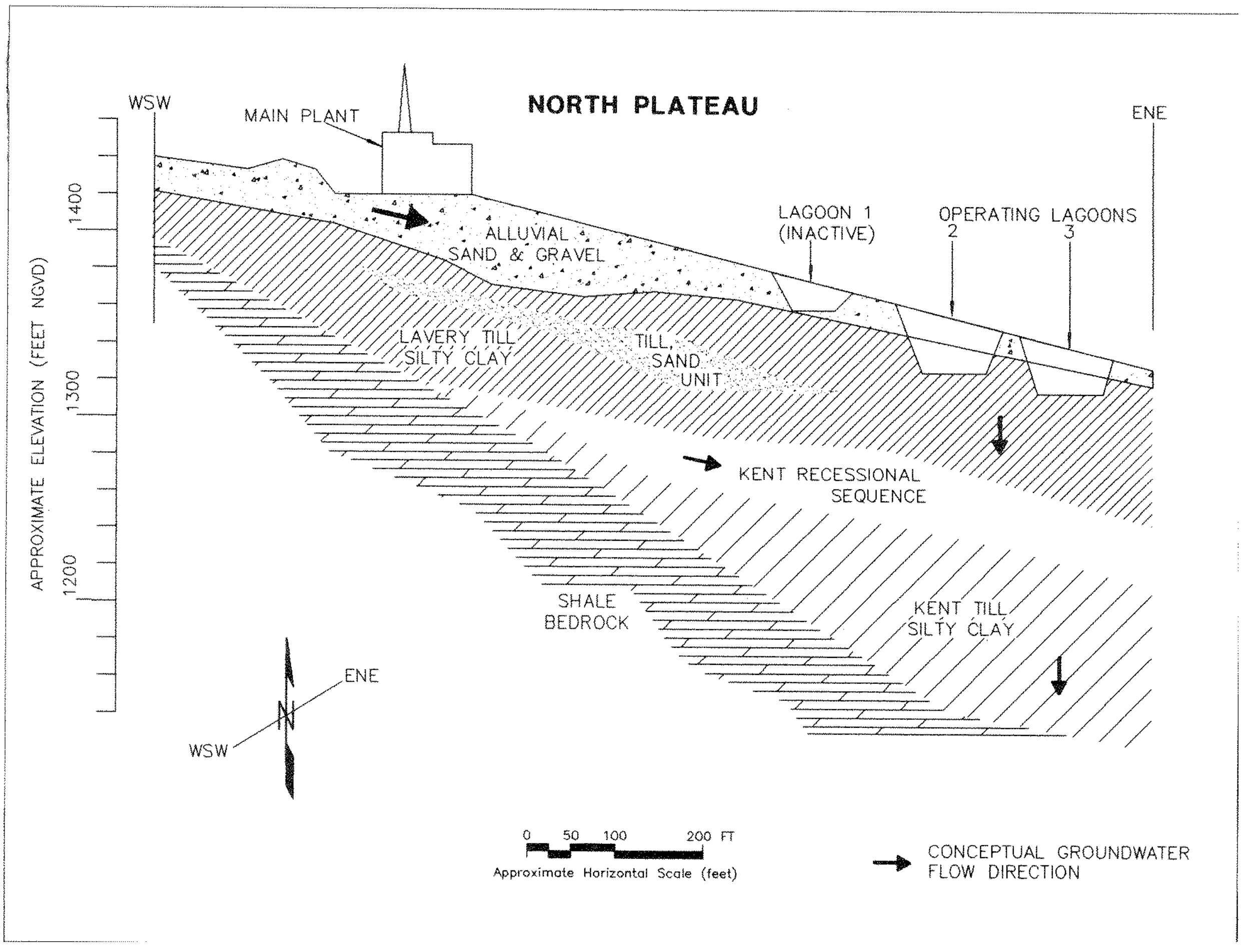


Figure 3-2. Geologic Cross Section through the North Plateau

is approximately 4 x 10^{-5} cm/sec (0.11 ft/day). Recharge comes from the overlying till and the bedrock in the southwest, and discharge is to Buttermilk Creek.

Underneath the recessional sequence is the less permeable Kent till, which does not provide a pathway for contaminant movement from the WVDP and so is not discussed here.

North Plateau

On the north plateau, where the main plant, waste tanks, and lagoons are located, the unweathered Lavery till is immediately overlain by the surficial sand and gravel layer. Within the Lavery till on the north plateau is another unit, the till-sand. A geologic cross section of the north plateau is shown on Figure 3-2.

Surficial Sand and Gravel Layer

The surficial sand and gravel is a silty sand and gravel layer composed of younger Holocene alluvial deposits that overlie older Pleistocene-age glaciofluvial deposits. Together these two layers range up to 12.5 meters (41 ft) in thickness near the center of the plateau and pinch out along the northern, eastern, and southern edges of the plateau, where they have been truncated by the downward erosion of stream channels.

Depth to groundwater within this layer varies from 0 meters to 5 meters (0 ft to 16 ft), being deepest generally beneath the central north plateau (beneath the main plant facilities) and intersecting the surface farther north towards the security fence. Groundwater in this layer generally flows across the north plateau from the southwest (near Rock Springs Road) to the northeast (towards Frank's Creek). Based on the testing of forty-one wells in 1995, the geometric mean hydraulic conductivity is 3.1 x 10^{-4} cm/sec (0.87 ft/day). These new data indicate higher velocities than noted in earlier site reports, which used a smaller data set of twenty-one wells. Groundwater near the northwestern and southeastern margins of the sand and gravel layer flows radially outward toward Quarry Creek and Erdman Brook, respectively. There is minimal groundwater flow downward into the underlying Lavery till.

Lavery Till-sand

On-site investigations from 1989 through 1990 identified a lenticular sandy unit of limited areal extent and variable thickness within the Lavery till, primarily beneath the north plateau. Groundwater flow through this unit apparently is limited by the cross sectional area of the unit's erosional exposure, and surface discharge locations have not been observed. Hydraulic testing in 1996 of seven wells screened in this unit indicated a mean conductivity of 1.1 x 10^{-3} cm/sec (3.1 ft/day).

South Plateau

A geological cross section of the south plateau is shown on Figure 3-3. The uppermost geologic

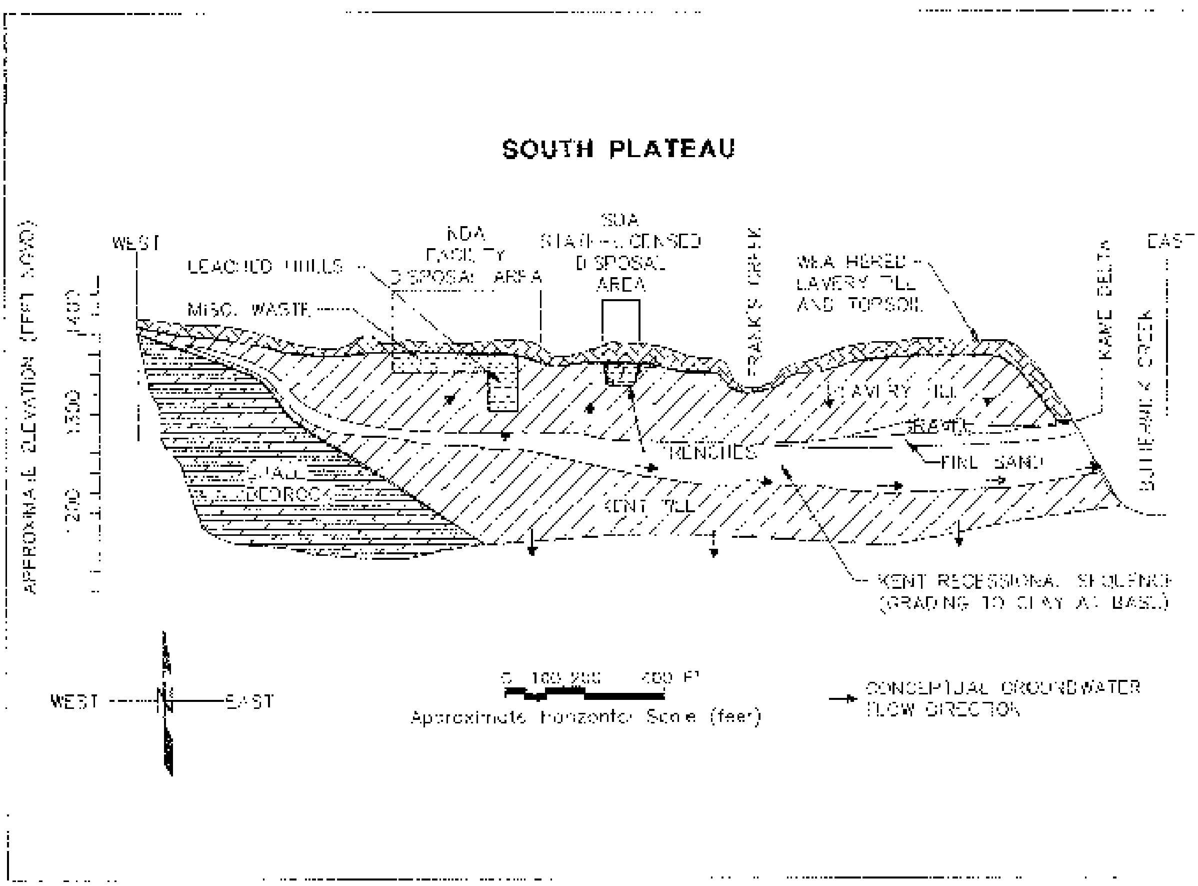


Figure 3-3. Geologic Cross Section through the South Plateau

unit, the weathered Lavery till, is discussed below. The other units (the unweathered Lavery till, the Kent recessional sequence, and the Kent till) were discussed above.

Weathered Lavery Till

On the south plateau, the upper portion of Lavery till exposed at the surface is referred to as the weathered till. It is physically distinct from the underlying unweathered till: it has been oxidized to a brown color and contains numerous fractures and root tubes. The thickness of this layer generally varies from 0.9 meters to 4.9 meters (3 ft to 16 ft). On the north plateau, the weathered till layer is much thinner or nonexistent.

Groundwater flow in the weathered till that occurs in the upper 4.9 meters (16 ft) has both horizontal and vertical components. This enables the groundwater to move laterally across the plateau before moving downward into the unweathered Lavery till or discharging to nearby incised stream channels. The hydraulic conductivity of the weathered till varies from 10^{-8} to 10^{-5} cm/sec (10^{-5} to 10^{-2} ft/day), with the highest conductivities associated with the dense fracture zones (found within the upper 2 meters [7 ft] of the unit).

Groundwater Monitoring Program Overview

Groundwater Monitoring Activities

Current groundwater monitoring activities at the WVDP are summarized in two primary documents, the Groundwater Monitoring Plan (West Valley Nuclear Services Co., Inc. December 1996) and the Groundwater Protection Management Program Plan (West Valley Nuclear Services Co., Inc. 1994). The Groundwater Monitoring Plan focuses on long-term monitoring requirements specified under the RCRA facilities investigation and DOE programs. The Groundwater Protection Management Program Plan provides additional information regarding protection of groundwater from on-site activities.

The categories of groundwater sampling parameters collected and the 1996 sampling schedule for these parameters are noted in Table 3-1. Potentiometric (water level) measurements also are collected from the wells listed in Table 3-2 (pp.3-22 through 3-27) in conjunction with the quarterly sampling schedule. Water level data is used to determine groundwater flow directions and gradients.

Monitoring Well Network

The purpose of groundwater monitoring is to detect changes in groundwater quality within the five different hydrogeologic units discussed above: the sand and gravel unit, the weathered Lavery till, the unweathered Lavery till, the Lavery till-sand unit, and the Kent recessional sequence.

Table 3-2 lists the eleven super solid waste management units (SSWMUs) monitored by the well network; the hydraulic position of each well within the waste management unit; the analytes measured in 1996; the geologic unit monitored; and the depth of each well. Note that monitoring of wells marked by an asterisk is required by the RCRA 3008(h) Administrative Order on Consent. (See the *Environmental Compliance Summary: Calendar Year 1996*, **RCRA Facility Investigation [RFI] Program** [p. xlviii].)

Figure 3-1 (p. 3-3) shows the boundaries of these eleven super solid waste management units at the WVDP. (Twenty-one of the wells are in the New York State-licensed disposal area [SDA] and are the responsibility of the New York State Energy Research and Development Authority [NYSERDA]. Although the SDA is a closed radioactive waste landfill contiguous with the Project

Table 3 - 1
1996 Groundwater Sampling and Analysis Agenda

ANALYTE GROUP	DESCRIPTION OF PARAMETERS [1]	LOCATION OF SAMPLING RESULTS IN APPENDIX E
Contamination Indicator Parameters (I)	pH, specific conductance (field measurement)	Tables E-1 through E-5 (pp.E-3 through E-10)
Radiological Indicator Parameters (RI)	Gross alpha, gross beta, tritium	Tables E-1 through E-5 (pp.E-3 through E-10)
Groundwater Quality Parameters (G)	Alkalinity, aluminum, calcium, chloride, iron, magnesium, manganese, nitrate/nitrite, phosphate, potassium, sodium, silica, sulfate, sulfide	Table E-6 (pp.E-11 through E-12)
RCRA Hazardous Constituent Metals (M)	Antimony, arsenic, barium, beryllium, cadmium, lead, chromium, mercury, nickel, selenium, silver, thallium	Table E-10 (pp. E-17 through E-24)
Volatile Organic Compounds (V)	Appendix IX VOCs (see Table E-7)	Table E-8 (p. E-16)
Semivolatile Organic Compounds (SV)	Appendix IX SVOCs (see Table E-7)	Table E-9 (p. E-16)
Expanded Compound List: V, SV, and Appendix IX Metals (E)	Appendix IX VOCs, SVOCs, and metals (see Table E-7)	Tables E-8, E-9, and E-10 (pp. E-16 and E-17 through E-24)
Radioisotopic Analyses: alpha, beta, and gamma-emitters (R)	C-14, Cs-137, I-129, Ra-226, Ra-228, Sr-90, Tc-99, U-232, U-233/234, U-235/236, U-238, total uranium	Table E-12 (pp. E-26 through E-27)
Strontium-90 (S)	Sr-90	Table E -12 (pp. E-26 through E-27)
Special Monitoring Parameters (SM)	Arsenic, aluminum, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, vanadium, zinc	Table E-11 (p. E-25)

[1] *Analysis performed at selected active monitoring locations only. See Table 3-2 for the analytes sampled at each monitoring location.*

1996 Quarterly Sampling Schedule:
1st Qtr - December 4, 1995 to December 13, 1995
2nd Qtr - March 4, 1996 to March 13, 1996
3rd Qtr - June 3, 1996 to June 14, 1996
4th Qtr - September 3, 1996 to September 16, 1996

premises, the WVDP is not responsible for the facilities or activities relating to it. Under a joint agreement with the DOE, NYSERDA contracts with the Project to obtain specifically requested technical support in SDA-related matters. The 1996 groundwater monitoring results for the SDA are reported in this document in *Appendix F* [pp. F-1 through F-9].)

Table 3-2 identifies the position of a monitoring location relative to the waste management unit. The wells monitoring a given hydrogeologic unit (e.g., sand and gravel, weathered Lavery till) also may be arranged in a generalized upgradient to downgradient order based upon their location within the entire hydrogeologic unit. The hydraulic position of a well relative to a SSWMU, i.e., upgradient or downgradient, does not necessarily match that same well's position within a hydrogeologic unit. For example, a well that is upgradient in relation to a SSWMU may be located at any position within a hydrogeologic unit, depending on the geographic position of the SSWMU within the hydrogeologic unit. In general, the following text and graphics refer to the hydraulic position of monitoring wells within their respective hydrogeologic units, thus providing a site-wide hydrogeologic unit perspective.

History of the Monitoring Program

The groundwater monitoring program is designed to support DOE Order 5400.1 requirements and the RCRA 3008(h) Administrative Order on Consent. In general, the nature of the program is dictated by these requirements in conjunction with current operating practices and historical knowledge of previous site activities.

Groundwater Monitoring Program Highlights 1982 to 1996

• WVDP groundwater monitoring activities began in 1982 with the monitoring of tritium in the sand and gravel unit in the area of the lagoon system.

• By 1984 twenty wells in the vicinity of the main plant and the NDA provided monitoring coverage.

• Fourteen new wells, a groundwater seep location, and the french drain outfall were added in 1986 to provide monitoring of additional units.

• Ninety-six new wells were installed in 1990 to support data collection for the environmental impact statement and RCRA facility investigations.

• A RCRA facility investigation expanded characterization program was conducted during 1993 and 1994 to fully assess potential releases of hazardous wastes or constituents from on-site SSWMUs. This investigation, which consisted of two rounds of sampling for a wide range of radiological and chemical parameters, yielded valuable information regarding the presence or absence of contamination at each SSWMU and was also used to guide later monitoring program modifications.

• Long-term monitoring needs were the focus of 1995 groundwater monitoring program evaluations. A comprehensive assessment reduced the number of sampling locations from ninety-one to sixty-five, for a more efficient and cost-effective program.

• Wells, analytes, and sampling frequencies continued to be modified in 1996 in response to DOE and RCRA monitoring requirements.

1996 Groundwater Monitoring Program Highlights

Analytical Trigger Limits

A new program using "trigger limits" for all chemical and radiological analytes was instituted in 1996. These pre-set limits are conservative values for chemical or radiological concentrations that were developed to expedite a prompt focus on any monitoring anomalies.

North Plateau Seep Monitoring

A 1994 survey of groundwater seepage along the edges of the north plateau identified a number of seeps where (northeastward-flowing) groundwater from the sand and gravel unit discharges at the ground surface (Fig. 3-4 [p.3-10]).

Nine seeps were selected for quarterly sampling for radiological indicators in order to demonstrate that contamination is not emanating along the plateau edge. The nine seeps were selected because the amount of water available for sampling would be sufficient and because they are downgradient of the gross beta plume. (See **Interim Mitigative Measures Near the Leading Edge of the Gross Beta Plume on the North Plateau** [p. 3-18].) The extreme northern and southern seeps were selected for sampling in order to broaden the coverage. (See Fig. 3-4 [p.3-10].)

Evaluation of the sampling results included comparing the concentrations of the chosen analytes to concentrations in samples from GSEEP, an historical seep monitoring location that is not influenced by the gross beta plume. Concentrations in seep samples also were trended to identify any increases over time. A full year of quarterly sampling shows that the concentrations of radiological indicators at the seeps are similar to concentrations in samples from GSEEP, indicating that gross beta contamination is not emanating from the plateau edge. (See **Results of Seep Sampling** [p. 3-14].)

Monitoring at the nine seep sampling locations is scheduled to continue semiannually. Sampling pipes were installed at six of the seeps before the third-quarter 1996 sampling round to improve the quality of samples previously collected at the ground surface and to reduce potential analytical interferences caused by turbidity. The turbidity of samples from these seeps was greatly reduced, allowing more accurate results to be obtained.

North Plateau Groundwater Recovery System Upgrades

Another improvement to the groundwater monitoring system was the addition of a third recovery well in the north plateau groundwater recovery system (NPGRS) to enhance recovery of gross beta contamination on the north plateau. This contamination is the result of previous nuclear fuel reprocessing activities conducted at the facility.

Other modifications included improving surface drainage to minimize the recharge of groundwater in areas of contamination.

Monitoring at Main Plant Area Well Points

Samples obtained from the main plant area well points are analyzed annually for radiological indicator parameters. In 1996 the need for continued monitoring at these well points was assessed, and the decision made to continue sampling only at well points A, C, and H because nearby active monitoring wells provide adequate coverage.

1996 Groundwater Monitoring Results

Successful implementation of the WVDP's groundwater monitoring program includes proper placement of groundwater monitoring wells, using appropriate methods of sample collection, reviewing analytical data and quality assurance information, and presenting, summarizing, and evaluating the resulting data appropriately. Data are presented in this report through tables and graphs.

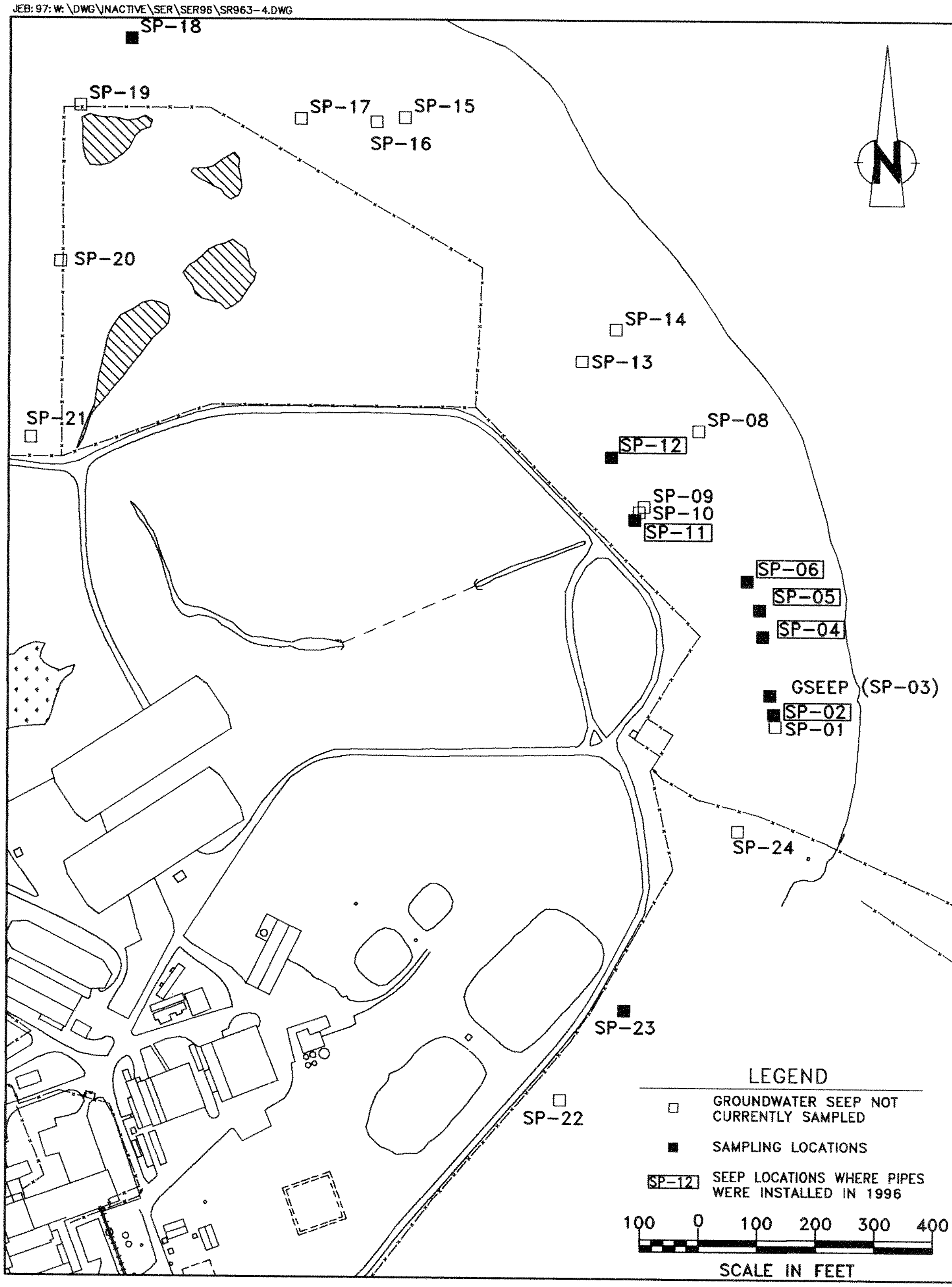


Figure 3-4. Seep Monitoring Locations in the Sand and Gravel Unit.

Four designations are often used to indicate a well's function within the groundwater monitoring program:

Upgradient well. *A well installed hydraulically upgradient of a SSWMU that is capable of yielding groundwater samples that are representative of local conditions and that are not affected by the SSWMU being monitored.*

Downgradient well. *A well installed hydraulically downgradient of a SSWMU that is capable of detecting the migration of contaminants from the SSWMU.*

Background well. *A well installed hydraulically upgradient of all SWMUs and SSWMUs that is capable of yielding groundwater samples that are representative of conditions not affected by site activities. In some cases upgradient wells may be downgradient of other SSWMUs or SWMUs, which makes them unsuitable for use as true background wells. However, they are still useful for providing upgradient information about the waste management unit under study.*

Crossgradient well. *A well installed to the side of the major downgradient flow path such that the well is neither upgradient nor downgradient of the monitored SSWMU.*

Presentation of Results in Tables

The tables in *Appendix E* (pp. E-1 through E-28) present the results of groundwater monitoring grouped according to the five hydrogeologic units monitored: the sand and gravel unit, the Lavery till-sand unit, the weathered Lavery till unit, the unweathered Lavery till unit, and the Kent recessional sequence.

These tables contain the results of 1996 sampling for the analyte groups noted on Table 3-1 (p. 3-7).

Table E-7 (pp. E-13 through E-15) lists the practical quantitation limits (PQLs) for individual analytes.

Appendix E tables also display each well's hydraulic position relative to other wells within the same hydrogeologic unit.

• Wells identified as UP refer to either background or upgradient wells that are upgradient of all other wells in the same hydrogeologic unit.

• Downgradient locations are designated B, C, or D to indicate their positions along the groundwater flow path relative to each other. Wells denoted as DOWN - B are closest to the UP wells. Wells denoted as DOWN - C are downgradient of DOWN - B wells but are upgradient of DOWN - D wells. DOWN - D wells are downgradient of all other wells on-site.

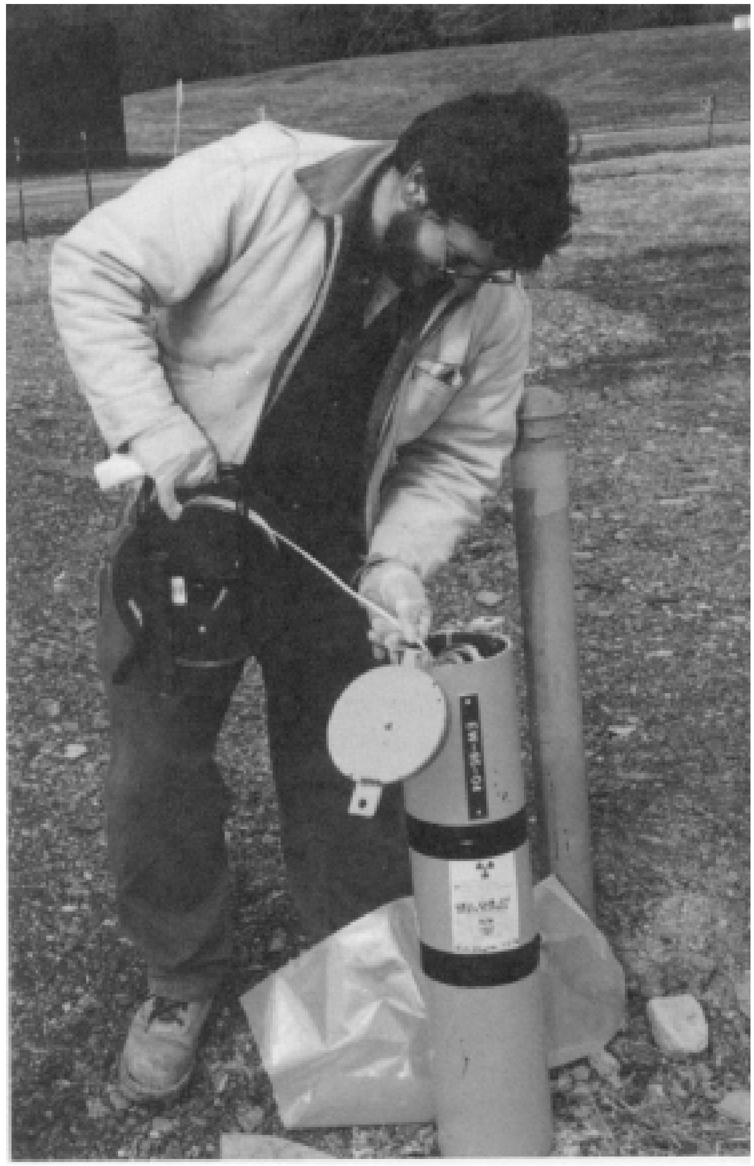
Grouping the wells by hydraulic position provides a logical basis for presenting the groundwater monitoring data in the tables and figures in this report.

These tables also list the sample collection periods. The 1996 sampling year covers the period from December 1995 (the first quarter of 1996) through October 1996 (the fourth quarter of 1996).

Presentation of Results in Graphs

In previous years well NB1S was used as the background reference well for the sand and gravel unit. However, background comparisons now use the collective monitoring results from three upgradient wells (301, 401, and 706) as a way of better representing the natural spatial variability within the geologic unit. Both DOE and NYSDEC have accepted the use of this collective background reference instead of well NB1S, and so the range of background values will be used here for purposes of comparison.

High-Low Graphs (pp. 3-28 through 3-37)



Measuring Water Levels in a Groundwater Monitoring Well

Graphs showing the 1996 measurements for contamination and radiological indicator parameters (pH, conductivity, gross alpha, gross beta, and tritium) have been prepared for all active monitoring locations in each geologic unit. These graphs allow results for wells within a given hydrogeologic unit to be visually compared to each other.

All the high-low graphs present the upgradient wells on the left side of the figure. Downgradient locations are plotted to the right according to their relative position along the groundwater flow path.

On the nonradiological graphs (pH and conductivity), the upper and lower tick marks on the vertical bar indicate the highest and lowest measurements recorded during 1996. The middle tick represents the arithmetic mean of all 1996 results. The vertical bar thus represents the total range of the data set for each monitoring location.

On the radiological graphs (gross alpha, gross beta, and tritium), the middle tick also represents the arithmetic mean of all 1996 results. However, the upper and lower tick marks on the vertical bar indicate the upper and lower ranges of the pooled error terms for all 1996 results. This format illustrates the relative amount of uncertainty associated with the measurements. By displaying the uncertainty together with the mean, a more realistic perspective is obtained. (See also *Chapter 5*, **Data Reporting** [p. 5-7].)

The sample counting results for gross alpha, gross beta, and tritium, even if below the minimum detectable concentrations, were used to generate the high-low graphs. Thus, negative values were included. This is most common for the gross alpha analyses, where sample radiological counting results may be lower than the associated instrument background.

Trend-Line Graphs (pp. 3-37 through 3-40)

Trend-line graphs have been used to show concentrations of a particular parameter over time at monitoring locations that have historically shown concentrations above background values. Results for the volatile organic compounds 1,1-dichloroethane (1,1-DCA) at wells 8609 and 8612, dichlorodifluoromethane (DCDFMeth) at wells 803 and 8612, and 1,2-dichloroethylene (1,2-DCE) at well 8612 are plotted in Figures 3-32, 3-33, and 3-34 (pp. 3-37 and 3-38). (See also Table E-8 [p. E-16]). Trends of gross beta and tritium at selected groundwater monitoring locations (104, 111, 408, 501, 502, 801, 8603, 8604, 8605, and GSEEP) are shown in Figures 3-35 through 3-36a (pp. 3-39 and 3-40).

The radionuclides present at the WVDP site are residues from the reprocessing of commercial nuclear fuel during the 1960s and early 1970s. A very small fraction of these radionuclides is released off-site during the year through ventilation systems and liquid discharges and makes a negligible contribution to the radiation dose to the surrounding population through a variety of exposure pathways.

Radiological Parameters Measured

Samples for isotopic analyses are collected regularly from sixteen monitoring points, which are located mainly in the sand and gravel unit and the weathered Lavery till. (See Table E-12 [pp. E-26 through E-27].)

Results from 1996 confirmed historical findings. Strontium-90 remained the major contributor to elevated gross beta activity in the plume on the north plateau. Concentrations of other isotopes either remained close to detection levels or were slightly above background (at specific wells within the gross beta plume and downgradient of inactive lagoon 1). In all cases, with the exception of strontium-90, these activities remain far below the DCGs and no increasing trends are evident.

Since concentrations of strontium-90 can be inferred from historical results as a percentage of gross beta concentrations, analyzing for both parameters is no longer needed: Results from the analyses for gross beta (allowing at least ten days for samples to reach equilibrium with respect to yttrium-90 ingrowth) can be multiplied by 40% to 50% to arrive at an approximation of the strontium-90 concentrations.

Technetium-99, iodine-129, and carbon-14 radionuclides, which were previously noted at several monitoring locations at concentrations above background levels, have been demonstrated to comprise very small percentages of total gross beta concentrations. While elevated levels have been noted at specific locations since 1993, none have been above DCGs, and gross beta analyses continue to provide surveillance on a quarterly basis.

Volatile and Semivolatile Organic Compounds

Volatile and semivolatile organic compounds were sampled at specific locations (wells 8612, 8609, 803, and 111) that have shown results above their respective practical quantitation levels (PQLs) in the past. (The PQL is the lowest level that can be measured within specified limits of precision during routine laboratory operations on most matrices.[New York State Department of Environmental Conservation 1991]. See Table E-7 [pp. E-13 through E-15] for a list of PQLs.) Other locations are monitored for volatile and semivolatile organic compounds because they are downgradient of locations showing positive results.

The 1996 trends in concentrations of the compound 1,1-dichloroethane (1,1-DCA) are illustrated in Figure 3-32 (p.3-37). Concentrations of 1,1-DCA at well 8612 remained consistent with results from previous years. At well 8609 1,1-

DCA was not detected at all during 1996, and at well 803 it was detected only once (below the PQL). Very low concentrations of 1,1-DCA also were detected at groundwater seep SP-12 during the fourth quarter of 1996; during a confirmatory resampling in November 1996 the compound was reported at estimated concentrations below the PQL. (See Table E-8 [p. E-16].)

Trends of dichlorodifluoromethane (DCDFMeth) concentrations are shown in Figure 3-33 (p. 3-38). The concentrations of DCDFMeth at well 8612 remained at low levels in 1996 — near the detection limit. DCDFMeth was identified at well 803 either at concentrations below the PQL or was not detected at all. At SP-12, DCDFMeth was identified at concentrations below the PQL during the fourth quarter of 1996 and again during the resampling in November 1996.

Other VOC trends (Fig. 3-34 [p. 3-40]) include 1,2-dichloroethylene (1,2-DCE) at well 8612, which increased slightly during the fourth quarter of 1996. (This compound was first detected in 1996.) Concentrations of the compound 1,1,1-trichloroethane (1,1,1-TCA) also were detected at well 8612 close to or below the PQL.

Aqueous concentrations of tributyl phosphate (TBP) were detected at well 8605 at much lower concentrations than in 1995. At well 111, which is next to well 8605, TBP was not found above the detection limit.

Possibly related to the ongoing detection of TBP in this area, 1996 monitoring data show the continuing presence of low, positive concentrations of iodine-129 and uranium-232 in wells 0111 and 8605, as noted in previous annual Site Environmental Reports. (See Table E-12 [p. E-26].) The presence of all three contaminants is consistent with the observation that these samples reflect historical fuel reprocessing and waste disposal activities in the former lagoon 1 area.

Results of Seep Sampling

Analytical results of sampling the sand and gravel unit seepage locations for radiological parameters have been time-trended and have been compared to the levels found at GSEEP, which has been monitored since 1991 and apparently exhibits no influences from the gross beta plume. There was one round of routine sampling for VOCs at seepage location SP-12 during 1996. (See **Volatile and Semivolatile Organic Compounds** [p. 3-13]). Results were compared to concentrations in wells downgradient of the CDDL.

Gross alpha and gross beta concentrations at the sampled seeps during 1996 remained similar in magnitude to GSEEP. (Seep SP-18 could not be sampled during the fourth quarter because it was dry. Seep SP-23 was dry during all four sampling rounds.) Gross alpha concentrations have remained particularly steady, but some fluctuations in gross beta are apparent. In general, the fluctuations follow the pattern of those measured at GSEEP. (See also Table E-14 [p. E-28].)

Tritium concentrations at the seeps also appeared similar in magnitude to those at GSEEP. Concentrations in all the seeps were slightly above background, and all locations indicated slight increases in 1996. Large negative values for tritium at SP-18 are believed to have resulted from interference by dissolved organic material in the undistilled sample. This interference reduces the efficiency with which the radiation detection instrumentation can quantify tritium concentrations and thus produces results that apparently are below background levels. Sampling from pipes has improved the water quality.

The results collected to date suggest that gross beta concentrations are within background levels. Modifications to the sampling locations were made in an effort to reduce the turbidity of samples. It is believed that the sediment in the samples may have contributed to the elevated gross alpha concentrations from naturally occurring alpha-emitting radionuclides in the soil. (Gross alpha results from the first quarter of 1996 were most notably affected.) Samples from GSEEP are collected via a small-diameter polyvinyl chloride (PVC) pipe; these samples typically contain less sediment, which indicates that the grab-sampling technique used at other seeps may be introducing sediment that affects radiological results. In mid-August, small-diameter slotted PVC pipes were inserted horizontally at locations SP-02, SP-04, SP-05, SP-06, SP-11, and SP-12 and are now being used for sample collection.

Long-term Trends of Gross Beta and Tritium at Selected Groundwater Monitoring Locations

Figures 3-35 through 36a (pp. 3-39 and 3-40) show the trends of gross beta activity and tritium at selected monitoring locations. These specific groundwater monitoring locations in the sand and gravel unit were selected for trending because they have shown elevated or rising levels of gross beta activity or steady or falling levels of tritium. Results are presented on a logarithmic scale to adequately represent locations of differing concentrations.

Gross Beta

The plume of gross beta activity on the north plateau (Fig. 3-5 [p.3-16]) continues to be monitored closely. Nine wells in the sand and gravel unit (104, 111, 408, 501, 502, 801, 8603, 8604, and 8605) contain elevated levels of gross beta activity, i.e., greater than 1.0E-06 μCi/mL, the DOE DCG for strontium-90.

The average background concentration is plotted on each graph for comparison purposes. All wells shown in these figures monitor the sand and gravel unit.

Figure 3-35a (p. 3-39) shows gross beta concentrations in wells 104, 111, 408, 501, 502, and 801 over the six-year period that the WVDP's current groundwater monitoring program has been in place.

As in previous years, well 408 continues to contain the highest gross beta levels. (Fig. 3-5 [p.3-16] and 3-35a.) Wells 104, 801, and 502 show increasing gross beta activities. Wells 111 and 501 show fairly steady concentrations.

• Figure 3-35 [p. 3-39] is a graph of gross beta activity at monitoring locations 8603, 8604, 8605, and GSEEP. The trend at 8604 appears to have leveled off after several years of steep increases. Results from well 8603 have continued to show a steady upward trend. The source of the increasing gross beta activity can be traced to the groundwater plume originating from beneath the former process building.

• Lagoon 1, formerly part of the low-level waste treatment facility, has been identified as a source of the gross beta activity at wells 8605 and 111. The gross beta concentrations at both wells have remained relatively steady over the entire eleven-year (well 8605) and six-year (well 111) monitoring periods.

Tritium

• Figure 3-36 (p. 3-40) shows the eleven-year trend of tritium concentrations at monitoring locations 8603, 8604, 8605, and GSEEP. Wells 8603 and 8604 indicate gradually declining trends in tritium.

• Figure 3-36a (p. 3-40) shows the tritium concentrations in wells 104, 111, 408, 501, 502, and 801 over the six-year period that the WVDP's current groundwater monitoring program has been in place. The figure shows that tritium concentrations in well 111 apparently have decreased over recent years.

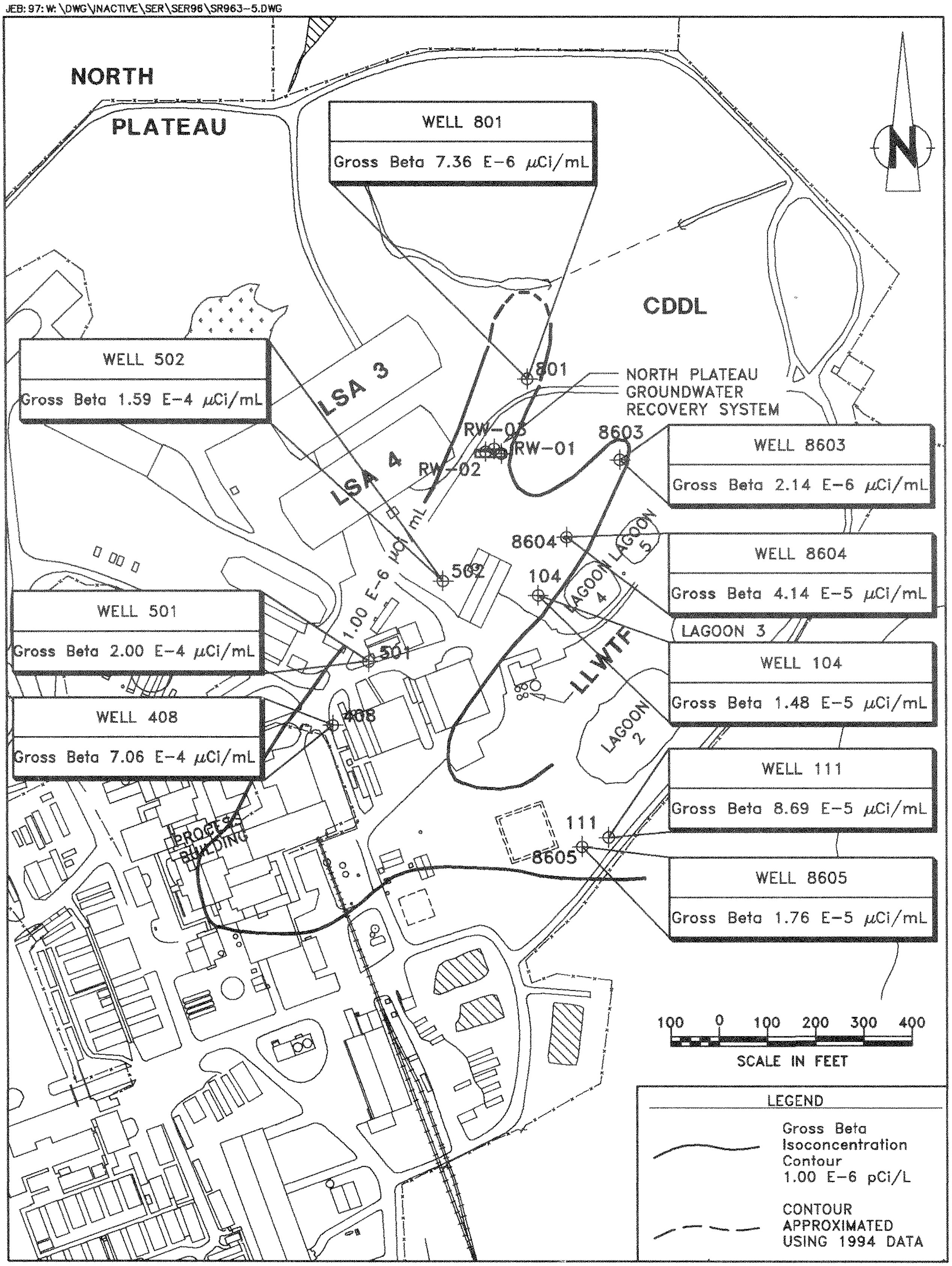


Figure 3-5. North Plateau Gross Beta Plume Area Fourth-Quarter 1996 Results.

JEB: 97: W: \DWG\INACTIVE\SER\SER96\SR963-6.DWG

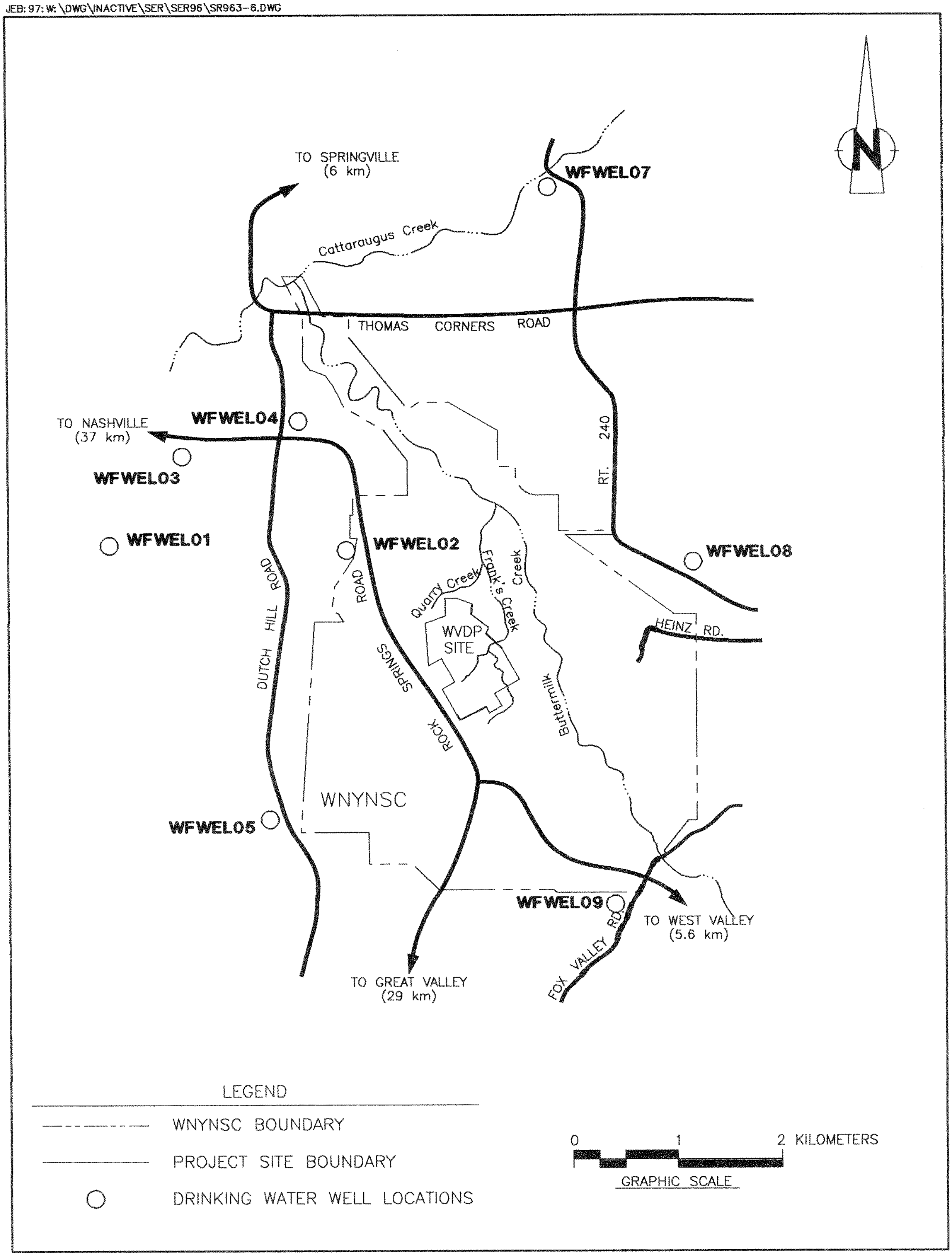


Figure 3–6. Off–site Groundwater Monitoring Wells.

Gross beta and tritium concentrations in samples from well 909 and location NDATR continued to be elevated with respect to other locations monitoring the NDA but also remained well below the DCGs. Gross beta results have historically fluctuated at these locations; the only discernible upward trend is in gross beta at well 909. Gross beta concentrations from well 909 are considerably higher than at NDATR and there has been speculation in the past concerning residual soil contamination as a possible source. As in the past, there were no monitoring results in 1996 that indicated the presence of n-dodecane/TBP.

Piezometers were installed in 1996 in the vicinity of the interceptor trench in order to assess the influence of trench pumping on the water table gradient. This data will be used to support evaluations of trench effectiveness.

Seven well points located downgradient of the process building were sampled annually between 1993 and 1996 for radiological indicator parameters. These well points are not associated with the north plateau groundwater recovery system (discussed below) and were installed in 1990 to supplement data collected from the groundwater monitoring wells installed during the same time frame.

An evaluation was conducted to determine the presence of trends, to compare concentrations to nearby wells, and to determine if adequate coverage was provided by other monitoring wells that are sampled quarterly under the current program.

The evaluation concluded that concentrations of gross alpha and gamma scan parameters (cesium-137, cobalt-60, and potassium-40) were below detection levels at all well points. While gross beta concentrations were elevated, they were within historical ranges in wells downgradient of the process building.

Well points A, C, and H have yielded samples with elevated concentrations of tritium with respect to historical monitoring of wells in the area. However, the tritium concentrations are well below the DOE derived concentration guide of 2.0E-03 μCi/mL. Data from downgradient monitoring wells have not indicated similarly elevated levels of tritium.

This area east of the process building and west of lagoon 1 may be an area of localized contamination, and it will continue to be monitored annually for contamination indicator and radiological indicator parameters in the future. Well points D, E, F, and G will not be sampled in future monitoring because adequate monitoring coverage is provided by active monitoring wells included in the groundwater monitoring program. Sampling will continue at well points A,C, and H to further evaluate the presence of tritium in this localized area.

Interim Mitigative Measures Near the Leading Edge of the Gross Beta Plume on the North Plateau

Elevated gross beta (from previous fuel reprocessing activities) has been reported historically in localized areas north and east of the former process building. In December 1993 elevated gross beta concentrations were detected in surface water at former sampling location DMPNE, located at the edge of the plateau. This detection initiated a subsurface investigation of groundwater and soil using the Geoprobe®, a mobile sampling system. The investigation was used to define the extent of the gross beta plume beneath and downgradient of the process building. The gross beta plume delineated was approximately 300 feet wide and 800 feet long.

The highest gross beta concentrations in groundwater and soil were located near the southeast corner of the process building. The maximum activity in groundwater was 3.6E-03 μCi/mL, and the maximum activity in soil reached 2.4E-02 μCi/g. Strontium-90 and its daughter product, yttrium-90, were determined to be the isotopes responsible for most of the elevated gross beta activity in the groundwater and soil beneath and downgradient of the former process building (West Valley Nuclear Services Co., Inc. 1995b).

In 1995 the north plateau groundwater recovery system (NPGRS) was installed as a mitigative measure for minimizing the spread of the gross beta plume. The NPGRS was located near the leading edge of a lobe of the plume where groundwater flows preferentially towards the edge of the plateau. The NPGRS initially consisted of two extraction wells (RW-01 and RW-02) to recover the contaminated groundwater. In September 1996 a third well (RW-03) was added to the NPGRS along with other system upgrades. The upgraded recovery system more effectively captures the contaminant plume in this area.

Water recovered by the NPGRS is treated by ion exchange to remove strontium-90. Treated water is transferred to lagoon 4 or 5 and then to lagoon 3 for ultimate discharge to Erdman Brook.

Special Monitoring for the North Plateau Groundwater Quality Early Warning Evaluation

An early warning evaluation of the monitoring well data was devised to guard against the possibility of changes in groundwater quality affecting the NPGRS or the low-level waste treatment facility (LLWTF) system. This monitoring is important since changes in the quality of recovered groundwater could ultimately affect compliance with effluent limitations on pollutants specified in the SPDES permit for outfall 001.

To guard against this possibility, an early warning system was devised: Quarterly monitoring results from three wells in the vicinity of the system are compared to early warning levels (multiples of the SPDES permit levels) in order to identify concentrations that may affect compliance with SPDES effluent limits. Two of the wells, 116 and 602, are used to monitor groundwater in the NPGRS drawdown vicinity. A third well, 502, is directly upgradient of the NPGRS and was sampled for additional parameters (mostly total and dissolved metals) not routinely analyzed under the groundwater monitoring program. Results of this special monitoring are found in Table E-11 (p. E-25).

During 1996 quarterly evaluations indicated that strontium-90 and some metals were elevated with respect to the early warning levels. A report was prepared in early 1996 that assessed the cation removal efficiencies for these and other metals (Dames & Moore June 1996). Paired influent and effluent samples from the NPGRS were analyzed to compare the concentrations and to estimate the removal efficiency of the treatment system. It was reported that up to 99% of the calcium and the beta activity (to which strontium-90 is a major contributor) were removed from the influent to the NPGRS. There also was evidence of the removal of other metals such as chromium and nickel. Best estimates for removal of chromium and nickel were reported as 76% and 26% respectively.

Results of Off-Site Groundwater Monitoring

Ten off-site wells, used by site neighbors as sources of drinking water, were sampled for radiological parameters, pH, and conductivity as part of the groundwater monitoring program during 1996. (See Fig. 3-6 [p. 3-17].) Sampling and analysis indicated no evidence of contamination by the WVDP of these off-site water supplies. Analytical results are found in Table C-1.26 (p. C1-20) in *Appendix C-1.*

Discussion of Site Groundwater Sampling

The 1996 groundwater monitoring program reflects the transition from data collection for site characterization to efficient ongoing monitoring surveillance based on process knowledge and years of groundwater data. Monitoring in areas such as the north plateau sand and gravel unit and the NDA continued in 1996. Data collection needs may be further modified as the RCRA facility investigation reports are made final and as monitoring data continue to be collected and evaluated.

Representatives from NYSDEC visited the site from June 10 through June 12, 1996, in order to conduct a comprehensive monitoring evaluation and to address the question of whether routine filtering of samples intended for radionuclide analyses was biasing the results. (Radioactive ions can adhere to colloidal particles in filtered samples.)

Both filtered and unfiltered samples were obtained from four wells and analyzed for metals and radionuclides. The wells chosen for sampling (104, 111, 801, and 8605) have shown elevated radioactivity in the past.

NYSDEC concurred that radiological parameter results from filtered and unfiltered samples were comparable and that no noticeable bias was apparent. All sampling procedures and documentation were found to be acceptable. NYSDEC also noted that the well maintenance program had been improved and that thirty-six of the older and inactive wells had been decommissioned.